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# Bioimpedance based Lab-on-a-Chip (LOC) systems for tissue engineering

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**Brief description of research area:**

The goal of our research is to develop a new proof of concept Lab-on-a-chip (LOC) system with integrated bioimpedance detection for the purpose of *real time monitoring* of the growth and viability of a vascularized 3D bioartificial liver-on-a-chip system (BAL-on-a-Chip). This project will be executed in synergy with the newly approved EU project NanoBio4Trans, which forms a new research direction within Nanotech's LOC strategic field.

The ultimate goal of the NanoBio4Trans project is to develop, optimise and validate a highly vascularised *in vivo*-like BAL as an extracorporeal bioartificial liver (EBAL) ready to be perfused with human blood plasma, in order to be exploited in the medical technology of the 21$^{th}$ century.

**What we know:**

The use of *human induced pluripotent stem cells* (hiPSC) can be exploited as the starting material to enable the construction of personalized artificial organs from a patient's own cells. These cells can be grown and directed to differentiate into *in vivo*-like BALs by employing scalable and perfusable hybrid three dimensional scaffolds.

Integrated optical and electrical biosensing systems can be used to monitor the effects and changes that occur during tissue growth. This allows control and surveillance of the BAL formation, with envisaged feed-back control.
To establish new challenging bioimpedance sensing strategies with high sensitivity, accuracy and resolution in a *3D cell culture* system and eliminate the influence of the capacitive effects of the electrode interface a specially adapted *four-point electrode system* will be designed and evaluated. Both commercial needle electrodes and *home-made microelectrodes* will be exploited.
Intra- and extracellular optical nanosensors (phosphorescence and fluorescence based) will be also developed and applied for a multi-parametric imaging and bioanalysis of cells, tissues and organs (integrity of vasculature, viability, $O_2$, pH, liver function, differentiation markers, etc) working in close collaboration with *Luxcel Biosciences* (luxcel.com).
The perfusable hybrid scaffold and sensing systems will be integrated into the BAL support system enabling *real time monitoring* and *control* of the effects of various parameters during its growth.